Remarks:

Reconsideration of the application is requested. This preliminary amendment is presented to make certain typographical corrections and stylistic changes.

Please charge any fees, which might be due with respect to Sections 1.16 and 1.17 to the Deposit Account of Lerner and Greenberg, P.A., No. 12-1099.

Respectfully submitted,

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In the Specification:

The following changes were made on Page 2, first full paragraph, lines 4 - 21:

During the transmission of optical signals of a particular frequency spectrum (a particular [band width] bandwidth) via an optical [conductor] waveguide of great length, for example an optical fiber, dispersion phenomena occur due to the frequency-dependent velocity of propagation of the light in the optical fibers, that is to say a distortion of the input light pulse/input bit sequence in dependence on the path length. This chromatic dispersion of the optical fibers limits the maximum distance which can be spanned with the high-bit-rate transmission systems. Thus, for example, the usual single-mode optical fibers with a dispersion of 17 ps/nm*km at a wavelength of 1550 nm allow a distance of only 80-100 km (50-65 miles) in 10 Gbit/s systems which can be spanned without dispersion compensation. Any further doubling of the [transmission band width] transmitted bandwidth reduces the maximum distance which can be spanned roughly by a factor of 4. The dispersion of the optical fiber must then be correspondingly compensated for in the case of longer transmission links.

The following changes were made on page 3, first full paragraph, lines 4 - 11:

Among the electronic compensation methods, there are firstly the pre-chirp techniques. They are based on generating a negative frequency chirp of the laser diode, thus providing for appropriate precompensation. Furthermore, a reduction of the input [band width] bandwidth can be achieved by suitable modulation methods such as single-sideband modulation, duo-binary modulation etc. and thus the maximum distance which can be spanned can be increased, the bit rate remaining the same.

The following changes were made on page 4, third paragraph, lines 18 - 3 of page 5:

Another optical compensation technique is based on the "chirped" Bragg gratings (implemented fiber-optically or integrated optically). Although the "chirped" Bragg gratings are somewhat more compact than the DCFs, they operate in reflection mode and must thus be combined with a circulator. Moreover, the dispersion [band width] bandwidth of a grating is limited and each individual wavelength channel must be separately compensated for. Furthermore, Bragg gratings which can be adjusted over a wide range of dispersion cannot be easily achieved because, in addition, the compensation [band width] bandwidth and the reflection coefficient are dependent on the adjusted dispersion.

The following changes were made on page 6, paragraph 5, lines 15 - 21:

A technical problem of the above-mentioned interferometric structures consists in that, without cascading, they only provide for very limited dispersion compensation while simultaneously requiring a wide dispersion [band width] bandwidth. The cascading necessary for this, in turn, unavoidably leads to a structure which is increasingly more difficult to implement and is more complex.

The following changes were made on Page 6, last paragraph, lines 32 - 7 on page 7:

Summary of the Invention:

The object of the present invention is to provide a dispersion compensator and a method for compensating for dispersion which overcome the above-noted deficiencies and disadvantages of the prior art devices and methods of this general kind, and wherein the system is capable of compensating for high dispersion values without cascading a number of filter stages and which, at the same time, has a [wide] broad [band width] bandwidth. Furthermore, the invention is intended to make it possible to generate adjustable dispersion values.

The following changes were made on page 8, second full paragraph, lines 11 - 18

In further summary, the inventor proposes here a structure which provides for high dispersion compensation at any

dispersion [band width] bandwidth without cascading a number of filter stages. It is based on combining the two part-signals of an asymmetric Mach-Zehnder without forming interference in spite of an existing coherence. This is possible when the two signals are mutually orthogonally polarized when the signal is being recombined

The following changes were made on page 12, third paragraph, lines 16 - 23:

If there is no linearly polarized polarization state at the input of the compensator or there is a linearly polarized input state which does not correspond to the directions of the principal axis of the [wave guides] waveguides of the compensator and, at the same time, the [wave guides] waveguides of the compensator are [ansisotropically] anisotropic [constructed], the two signals with the different frequency bands are no longer orthogonally polarized when they are being combined.

The following changes were made on page 12, last paragraph, lines 25 - 6 on page 13:

To recover the orthogonality in this case, it is also proposed in a special refinement of the invention that a fast controllable TE/TM phase shifter is arranged in at least one transmission link of the Mach-Zehnder, preferably behind the polarization converter. This makes it possible to ensure the orthogonality of the recombination signals when they are being

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combined by suitably driving the TE/TM phase shifter in the case of anisotropic [wave guides] <u>waveguides</u>.

<u>The following changes were made on page 16, last paragraph, lines 24 - 2 on page 17:</u>

Fig. 5 is a diagram showing dispersion compensation as in Fig. 4 but expanded by a TE/TM phase shifter for compensating for birefringent [wave guides] <u>waveguides</u> at any homogenous elliptical input polarization state;

<u>The following changes were made on page 17, last paragraph, lines 15 - 2 on page 18:</u>

Description of the Preferred Embodiments:

Referring now to the figures of the drawing in detail and first, particularly, to Fig. 1 thereof, there is seen a diagrammatic illustration of a prior art assembly for compensating for dispersion with the aid of an asymmetric Mach-Zehnder interferometer having an input 15 and two outputs (output 1 and output 2) at 16. The elementary functions necessary for compensating for dispersion such as the spectral division of the signal with the aid of a frequency division multiplexer (FDM) 1, the spectrum-dependent time delay ΔL ($\Delta\tau$) and the signal recombination in a multiplexer 3 are implemented on a common [starting] substrate in the case of an integrated implementation.

The following changes were made on Page 18, second full
paragraph, lines 15 - 21:

This configuration represents a filter stage. The phase

relationship of the waves interfering in the multiplexer 3

must not change too much as a function of the frequency in

order to be able to achieve the desired compensation [band

widths] bandwidths without much intensity and time delay

ripple. However, this requirement limits the maximum

achievable delay time $\Delta\tau$, and thus the dispersion per filter

stage.

The following changes were made on page 18, last paragraph,
lines 23 - 6 on page 19:

As a consequence, it is only possible to achieve large

dispersion compensation over a [great] large [band width]

bandwidth by cascading a number of asymmetric Mach-Zehnders

(filter stages). Such an implementation, normally used in the

prior art, is shown in Fig. 2. The individual asymmetric Mach-

Zehnder interferometers are here connected to one another by

directional couplers 5 and, at the same time, fulfill the

functions of frequency division multiplex, frequency-dependent

delay, and frequency division demultiplex.

The following changes were made on Page 19, first full
paragraph, lines 8 - 19:

Due to the cascading, a progressive coherent [overloading]
superposition of the wave components of the two interferometer
arms is generated. The greater the desired dispersion
compensation with simultaneous large [band width] bandwidth,
the more cascading stages are required. Thus, the
implementation becomes increasingly more difficult, especially
since the optical path length or, respectively, the phase of
each interferometer or, respectively, of each filter stage,
must be precisely monitored. This may be done by a thermo-
optical phase shifter. Configurations with virtually
arbitrarily adjustable compensation values, possibly by means
of adjustable couplers, are conceivable but again increase the
complexity.

The following changes were made on page 19, last paragraph,
lines 21 - 5 on page 20:

Fig. 3 shows a structure according to the invention of an
optical dispersion compensator analogously to Fig. 1. Here,
however, a polarization converter 6 is additionally inserted
in the Mach-Zehnder arm 4.1 (interferometer arms). The aim is
to achieve a signal recombination of two frequency bands
without interference being formed due to their orthogonal
polarization states. By appropriately dimensioning ΔL
(difference in length of the Mach-Zehnder arms), time delays

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$\Delta\tau$ of the frequency band f_H can be achieved which have any

magnitude, and this with a total [band width] bandwidth of the

signal $f_L + f_H$ which, at the same time, is of any magnitude.

The following changes were made on page 20, last paragraph, lines 7 - 24:

The assembly firstly consists of the frequency demultiplexer

(FDM) 1 which divides the input spectrum into two frequency

bands f_L and f_H. The FDM 1 ideally has a rectangular frequency

response, i.e. having edges which drop off as steeply as

possible. In the asymmetric Mach-Zehnder interferometer

following, the two frequency bands f_L and f_H are subjected to a

different propagation delay. In the case of isotropic and, at

the same time, polarization-maintaining [wave guides]

waveguides as is basically possible, for example, with an

integrated optical form of implementation, the polarization

input state as drawn in Fig. 3 can have any elliptical shape.

The polarization states are specified by the configuration of

the ellipses shown. The polarization converter then converts

the signal of the Mach-Zehnder arm 4.1 from an arbitrarily

elliptically polarized state into an elliptically polarized

signal which is orthogonal thereto. This signal is then

combined with the time-delayed signal from the Mach-Zehnder

arm 4.2 in the multiplexer 3.

The following changes were made on Page 21, first paragraph, lines 1 - 6:

The multiplexer 3 in which the two frequency bands are combined and superimposed again may consist, in a simple implementation, of a [broad band] broadband 3dB coupler which entails an additional power loss of about 3dB. In that case, an output of the multiplexer 3 can be used as monitor output. This can be used for monitoring the output power.

The following changes were made on page 21, second paragraph, lines 8 - 16:

If, as shown in Fig. 3, the configuration consists of isotropic [waive guides] waveguides, an arbitrary elliptical polarization state of the input signal is permissible for its correct operation and the ellipse should be as identical as possible over the entire channel [band width] bandwidth. In the case of a linear input polarization state with identical axes, the multiplexer can be implemented by a TE/TM polarization combiner which makes it possible to combine the signals without 3dB power loss.

The following changes were made on page 21, last paragraph, lines 18 - 3 on page 22:

[In the case of weakly or non-dispersive wave guides the] The dispersion of the transmission link is only roughly approximated by the two-stage time delay in the case of weakly

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or non-dispersive waveguides, which, however, can lead to a considerable improvement in the signal. Suitable dimensioning of the delay line ΔL can result in a two-stage time delay $\Delta \tau$ of any magnitude without cascading which means considerable simplification, especially in the case of large compensation values. Furthermore, the configuration manages without an adjustable phase shifter. The configuration thus needs no further corrective control with permanently set FDM, polarization converter and multiplexer.

The following changes were made on Page 22, first full paragraph, lines 5 - 8:

If the dispersion of the transmission link is to be simulated ideally, it can be attempted to use in the Mach-Zehnder arms dispersive [wave guides] waveguides which have to be especially developed for the purpose.

The following changes were made on page 22, last paragraph, lines 20 - 3 on page 23:

The configuration shown in Fig. 4 requires, analogously to Fig. 3, ideally either an identical homogenous input polarization state over the entire channel frequency [band width] bandwidth and, at the same time, isotropic [wave guides] waveguides, or a linear TE or TM input polarization state with arbitrarily anisotropic [wave guides] waveguides to function correctly. The configurations according to Figs. 3

and 4 are, therefore, particularly suitable for dispersion
compensation preceding the transmission link, for instance
directly following the [transmit] emission laser with its
defined linear polarization state.

The following changes were made on page 23, first full
paragraph, lines 5 - 17:

If the configuration according to Fig. 4 can only be
implemented by means of anisotropic [wave guides] waveguides,
it is necessary to use an adjustable TE/TM phase shifter 9 in
one of the two Mach-Zehnder arms to obtain correct operation
of the dispersion compensator with an arbitrary homogenous
elliptical input polarization state. As shown in Fig. 5, this
phase shifter can be arranged, for example, following the
polarization converter 6. The phase shifter 9 ensures that the
two interferometer signals in the Mach-Zehnder arms 4.1 and
4.2 are orthogonal when they are combined. In this
configuration, the TE/TEM phase shifter 9 must compensate for
the accumulated difference in anisotropy of the two Mach-
Zehnder arms.

The following changes were made on page 23, last paragraph,
lines 19 - 24, replace the entire paragraph with the
following:

For the general case of anisotropic [wave guides] waveguides
of the dispersion compensator, the input polarization state
can also be rotated by an additional preceding polarization

controller in such a manner that it is linearly polarized and, at the same time, corresponds to one of the [wave guide] waveguide axes of the dispersion compensator.

The following changes were made on page 24, second paragraph, lines 7 - 15:

The polarization controller 17 of the configurations according to Figs. 6a, 6b controls the polarization state in such a manner that it corresponds to the principal axes of the [wave guides] waveguides of the subsequent dispersion compensator 18 (TE or TM polarization). The principal axes of the [wave guides] waveguides of the subsequent dispersion compensator 18 are thus allowed to have any anisotropy. At the same time, the polarization controllers 17 of Figs. 6a, 6b can be used for compensating for the polarization mode dispersion to a limited extent.

The following changes were made on page 24, last paragraph, lines 17 - 3 on page 25:

As a further variant for an application of the configurations following the transmission link as shown in Figs. 3 and 4, it would be conceivable to use a preceding fast polarization scrambler 13 followed by a TE or TM polarizer 14. In this case, the [wave guides] waveguides 4.1, 4.2 of the dispersion compensator 18 are allowed to have any anisotropy since the input polarization state of the light wave is oriented in the

direction of one of the principal axes (TE or TM polarization) by the preceding polarizer 14. The polarization scrambler 13 is used either at the link input or directly before the compensation element with the preceding polarizer. In any case, the polarizer should be used immediately preceding the actual compensator element.

The following changes were made on Page 26, lines 1 - 7:

Overall, this invention provides a dispersion compensator and a method for compensating for dispersion which is able to compensate for high dispersion values without cascading a number of filter stages and, at the same time, has a great [band width] bandwidth. Furthermore, the invention makes it possible also to generate adjustable dispersion values.